THE GENERA BALANSIA AND DOTHICHLOE IN THE UNITED STATES[1] WITH A CONSIDERATION OF THEIR ECONOMIC IMPORTANCE.

BY GEO. F. ATKINSON.

BALANSIA.

The genus Balansia was described by Spegazzini[2] twenty-five years ago from specimens collected on spikes of Setaria or Pennisetum in Brazil. The genus in some respects bears a relationship to Claviceps but in other respects is widely different. The mycelium infests the inflorescence or stems of certain grasses forming a stroma or pseudosclerotium in which are mingled the tissues and parts of the affected host. A cross section then shows a mass of fungus tissue with parts of the host here and there as shown in Plates 81-83. In some species and especially in the earlier ones described the fruiting stromata, which are outgrowths from the vegetative stroma or sclerotum, are many of them stipitate and capitate thus resembling Claviceps purpurea, but different from Claviceps in the stroma being composite, that is, it consists of host elements intermingled with the fungus elements. Furthermore the fruiting stromata are formed during the same season and not after the sclerotium passes a period of rest as in Claviceps. Many of the fruiting stromata, however, are sessile, and both stipitate and sessile ones are found intermingled in *Balansia claviceps* Speg. (see Plate 87, fig. 21), the type specimen, and in others. The conidial stage is also different from that of Claviceps in the species in which it has been found. The sessile fruiting stromata resemble in form and color the hemispherical or oval stromata of certain species of Hypoxylon.

In 1875 Dr. Chas. Peck[3] described a new species of fungus on young fruiting spikes of Danthonia spicata from Sandlake, N. Y., as *Epichloe hypoxylon,* with the remark that "in shape and color this plant is suggestive of the genus Hypoxylon, but its habitat and spores point to Epichloë." This species has been found since but a few times and is not well understood judging from certain specimens distributed in herbaria as *Hypocrea hypoxylon* (Pk.)[4] and from the treatment of the species by Saccardo[5] who placed it in Hypocrella (*Hypocrella hypoxylon* (Pk.) Sacc.)

[1] Contributions from the Botanical Department, Cornell University No. 107.

[2] Fungi Argentini, Pugillus 1, No. 253, 1880.

[3] 27th Rept. New York State Mus., 108, 1875.

[4] Ellis and Everhart N. A. F., No. 2373 on Panicum agrostoides, Jackson, Miss., 1889.

[5] Sylloge Fung., *2*, 581, 1883.

and by Ellis[6] who followed Saccardo using the combination *Hypocrella hypoxylon* (Pk.), but also included as synonyms *Hypocrea atramentosa* B. & C., and *Dothidea vorax, atramentaria* and *pilulaeformis* of B. & C., and Cooke[7] says "according to specimens in Ellis & Everhart's North American Fungi, this" — (*Epichloe hypoxylon Pk.*) — "is identical with *Hypocrella atramentosa* Berk. & Curt., in Saccardo Syllog, No. 5066." This confusion in the identity of the plant led me into a serious mistake several years ago because I accepted specimens of a fungus marked "*Hypocrea hypoxylon* Pk.," distributed in several herbaria as identical with Peck's species, not having had access at that time to the type specimen. The specimens marked "*Hypocrea hypoxylon*" to which I refer, it was easy to see were identical with *Hypocrea atramentosa* B. & C., which is quite common on blades of Andropogon and other grasses in the Southern States as I had occasion during my residence in Alabama to learn. Unfortunately therefore the *Epichloe hypoxylon* Pk., and *Hypocrea atramentosa* B. & C., were considered by me at that time to be identical, when in reality I had seen only specimens of the latter, some of which had been determined as *Epichloe hyphoxylon* by a misunderstanding. At that time *Hypocrea atramentosa* B. & C., was made by me the type of a new genus *Dothichloe*.[8] While it was intended, therefore, that *Hypocrea atramentosa* B. & C., should be the type of the new genus Dothichloë, and it was the plant which I had especially in mind for the type species, unwittingly the name of an entirely different fungus (*Epichloe hypoxylon* Pk.) was included. Since this species name was the earlier one it was employed with the result that *Dothichloe hypoxylon* (Pk.) would actually refer in name to a plant which did not at all agree with the concept of the species actually used as the type of the genus. A few years ago I had an opportunity of examining the type of *Epichloe hypoxylon* in the State Herbarium at Albany and found that it was an entirely different plant from *Hypocrea atramentosa* B. & C.

It is in fact a Balansia as I discovered in my study of this species in 1901. During that year Professor Kellerman collected a considerable quantity of fine material at Vinton, Gallia Co., Ohio, on Danthonia spicata some of which he communicated to me. The pseudosclerotium is curved, more or less irregularly formed in the spike, 4-8 mm. long and 2-3 mm. in diameter. It is gray in color, whitish within, often with irregular rifts in the interior between adjacent elements of the spike. The layers are composed of the interwoven threads of the fungus with disintegrated remnants of the cells of the palae, leaves, axils, etc., of

[6] Ellis, North Am. Pyren., 91, 1892.
[7] Grev., *19*, 80, 1891.
[8] Steps toward a revision of the linosporus species of graminicolous Hypocreaceae, Bull. Torr. Bot. Club, *21*, 220, 1894.

the host, in walls of the rifts. The stromata (fruit bodies) are black on the exterior, whitish within, and are somewhat obovate, depressed and sessile, from 1-2 mm. broad and about 1 mm. high, the surface minutely papillate from the slight but evident elevations at the opening of the perithecia. In depauperate specimens fruit bodies are not well formed. The perithecia are immersed in the fruit body, ovate to flask-shaped and 300-400x150-200 μ, the wall not very distinct from the stroma but quite evident in stained preparations. The asci are quite mature in these specimens, are 150-200 x 7-8 μ, with a small cap "cell" and tapering at the base. The spores are filiform, eight in number and nearly the length of the acus, about 1 μ in diameter. The segments are 3-4 μ long.

I have also received specimens of the same species from Dr. R. Thaxter collected on Danthonia spicata at New Haven, Aug. 1889, and at Kittery Point, Me., Aug., 1901. I have seen specimens sent to Dr. Peck and collected by J. L. Sheldon on Danthonia spicata in Connecticut, July 17, 1901.

During 1900 and 1901 Professor W. H. Long collected what is probably the same species in Texas on an undetermined grass and deposited some of the material in the Herbarium of the Botanical Department of Cornell University. This material Mr. Long recognized as belonging to the genus Balansia. The fungus attacks apparently the very young inflorescence or young leaves or both, forming a pseudosclerotium, gray to blackish in color outside and white within, about 4 to 10 or 15 mm. long and 2-4 mm. in diameter, composite in character as in the case of the specimens from Ohio. On these are formed the hemispherical to subglobose fruiting stromata, black on the outside and whitish within, and punctate with the minute slightly projecting ostiola of the perithecia. The perithecia are flask-shaped, immersed, and 200-270 x 100-120 μ, the wall as in the Ohio specimens not very distinct from the stroma but evident in stained preparations. The asci are not as mature as in the Ohio specimens, are cylindrical with a tapering pedicel, and hyaline cap "cell," 120-150 x 6-7 μ. The spores are eight in number, nearly the length of the ascus and are about 1 μ in diameter. The Texas specimens are not so mature as the Ohio specimens, and this probably acounts for the fact that the spores examined were not separated into segments. This probably also accounts for the smaller size of the perithecia and asci. The stromata are not so constricted at their point of attachment to the sclerotium as those of the Ohio specimens. Otherwise the material from Texas and Ohio agree specifically, and the difference noted when the differences in age taken into account would not warrant the separation of the two into distinct species, unless inoculation experiments and studies of development should show them to be specifically distinct.

In some of the Texas specimens the young sclerotium was covered with a fine white powder consisting of short acicular

conidiophores 3-4 μ in diameter, bearing obovate to elliptical or fusoid, hyaline conidia 3-4 x 1.5-2 μ. At first this was supposed to be the conidial stage, but this does not seem probable in view of the fact that the conidial stage of *Balansia trinitensis* C. & M. is an Ephelis,[9] and an Ephelis has also been found several times on the sclerotium on Danthonia spicata even accompanying the Balansia stage in the case of the Ohio specimens. The conidial fungus on the few Texas specimens may have been a parasite os saprophyte, or indeed a second conidial stage, corresponding to the microconidia of some Sphaeriales, but development studies will be necessary to determine this point.

In examining the specimens carefully I discovered on some of the Ohio material the conidial stage which is of the Ephelis type, and it proved to be the *Ephelis borealis*[10] E. & E. The conidial stage *Ephelis borealis* as an " imperfect fungus" is to be found among the Excipulaceae. The conidial fructification is a disk-shaped or cup-shaped structure resembling some forms of the Perzizales, but long slender conidia are found on the disk (Plate 86, figs. 15, 16). The discovery of a conidial fructification of the Ephelis type is additional evidence that this species is a Balansia, for Cooke[11] and Massee have shown that *Ephelis trinitensis* C. & M. is the conidial stage of *Balansia trinitensis* C. & M.

In 1854 Berkeley described *Dothidea vorax*[12] as follows:

"485. Dothidea vorax Berk. et Curt. Spicis deformibus caulibusque innascens, subglobosa vel omnino effusa, nigra, granulata; cellulis minutis; ascis cylindriciis obtusis fragilissimis; sporidiis filiformibus.

"Hab. on the deformed spikes of some *Carex,* Khasia (Churra), Aug. (Dr. Hooker.) On *Uniola* and *Panicum,* Rev. M. A. Curtis, South Carolina.

"Black, subglobose, varying in size from a mere speck to that of a millet seed, or altogether effused, minutely granulated. Cells minute. Asci cylindrical, obtuse, curved, very fragile, spores filiform, extremely slender.

"Nothing can be at first sight more different than the effused specimens on the stem of *Uniola;* but others on *Uniola* are much larger than the Khasia specimen, insomuch that the species was first named *D. pitulaeformis.*"[13]

---

[9] A new development of Ephelis, Ann. Bot., *3,* 33-40, pl. 4, 1889.

[10] Jour. Mycol., *1,* 86, 1885. See also Ellis N. Am. Pyren., 91, 1892, where he says Ephelis borealis is only the stylosporous stage of Hypocrella hypoxylon (Pk.).

[11] A new development of Ephelis, Ann. Bot., *3,* 33-40, pl. 4, 1889.

[12] Hooker's Jour. Bot., *6,* 227, 1854 (I am under obligations to Dr. W. A. Murrill, N. Y. Bot. Gard., for the date of this publication). Decades Fung i, XLIX, L, p. 3, No. 485.

[13] In the first publication of the name *"D. pitulaeformis"* there appears to be a typographical error, since Berkeley evidently intended *"D. pilulaeformis"* (from *pilula* = a little ball in allusion to minute rounded

In September 1903 I had the opportunity of examining the type material of *Dothidea vorax* B. &. C. in the Herbarium of the Royal Gardens at Kew, England. This species is based on two different genera and three species. The part of the type on spikes of Carex from India is a Balansia, while the part on Panicum from South Carolina is probably *Hypocrea atramentosa* B. & C.

The Balansia specimens of the *Dothidea vorax* B. & C. resemble in some respects the *Epichloe hypoxylon* Pk., but I believe it differs sufficiently to retain it as a distinct species. The sclerotium is much larger, more irregular and of a coarser structure while the fruiting stromata have also a coarser and rougher exterior and are not so prominently constricted at the point of attachment to the substratum. But it is a closely related species, striking out the effused forms on Uniola and Panicum from South Carolina. Saccardo[14] in 1883 founded the genus Ophiodothis on *Dothidea vorax* B. and C., since it was not propely located in Dothidea. Ophiodothis, however, cannot stand for this species since Balansia antedates it by three years.

Under what genus name then shall these specimens of Balansia stand? *Balansia* Spegazzini (l. c.) was well founded in 1880. but the genus Ephelis Fries was founded in 1849.[15] Although the type species was an imperfect fungus it was placed in the discomycetes. Phillips[16] uses Ephelis in an entirely different sense for that of true discomycetes with ascigerous forms having no relationship to the true Ephelis, which is the conidial stage of Balansia, one of the Hypocreales. In fact the type species, *Ephelis mexicana* Fr., may be the conidial stage of the Balansia collected by Long from Texas, and Ellis (l. c.) suggests, in the description of *E. borealis* on Danthonia spicata from Nova Scotia, that it may be identical with *E. mexicana* Fr. Since Ephelis represented at first an imperfect stage it should not I believe replace a well founded genus of a perfect form though described at a later date, though I am aware that some writers probably hold the opposite view. Balansia Spegazzini then is the proper genus name to employ, and the diagnosis emended may be given as follows:

BALANSIA Spegazzini, Fungi Guar. Pugill. I, 1880 Emend. Atkinson.

Sclerotium composite, formed of the affected parts of the host, which are imbedded in a well developed and more or less compact fungus tissue, the elements of which also penetrate the

---

stromata). In later publications the latter orthography is used. However, the species name has no standing, since a description of it under this name was never published. See note relative to this later in the present article.

[14] Syll. Fung., *2*, 652, 1883.

[15] Summa Veg., Scand., 370, 1849.

[16] Manual Brit. Disc., 358, 1887.

host, and fill the spaces between leaves, palae, etc., when these are involved as is the case when the fruiting axes of the host are affected. Stromata arising from the sclerotium, stipitate and capitate, or sessile, pulvinate, obovate, discoid, or separated from the sclerotium by a constriction, germinating from the sclerotium as soon as the latter is mature, surface slightly papillate from the ostiola of the immersed perithecia. Stroma well developed so that the bases of the perithecia are separated from the pseudosclerotium or host by abundant fungus tissue even in the sessile forms. Asci aparaphysate, 8-spored. Spores filiform, nearly equaling the asci. Conidial stage when present, so far as known, of the ephelial type, and preceding the stromata.

But what specific name shall be used to designate the species in the United States? We cannot be certain that *Ephelis mexicana*[17] Fr. is the conidial stage of the Balansia from Texas, though I believe very likely it is. While some would employ the earliest specific name, even though applied to an imperfect form,[18] the better usage seems to be that which recognizes the earliest specific name applied to the perfect form[19] and *Balansia hypoxylon* is also a more appropriate name than Balansia mexicana. Pending the action of the International Botanical Congress at Brussels in 1910 it seems advisable to follow this usage.

In referring to the effused specimens on the stems of Uniola from South Carolina Berkeley says,[20] "Nothing can at first sight be more different than the effused specimens on the stem of *Uniola;* but others on Uniola are much larger than the Khasia specimen insomuch that the species was first named *D. pilu-*

[17] While the genus Ephelis was founded by Fries in 1849 (Summa Veg. Scand., 370) he does not appear to have published the specific name nor a specific description. Berkeley in Cuban Fungi (Jour. Linn. Soc., *10*, 353, 1869) gives a description of the species as follows:

"567. Ephelis mexicana Fr., Fung. Mex. (729). On the inflorescence of grasses, which it changes into a black solid mass, somewhat after the fashion of *Dilophosporium. Hab.* Mexico. Hymenium exposed, bearing slender thread-like spores .001 inch long, on delicate sporophores. The fungus resembles a *Peziza* on a black solid stroma."

For *Ephelis mexicana* Fr. writers usually cite both Fries' *Summa Veg. Scand.,* and *Fung. Mex.* Thus far I have failed to find any trace of such a publication by Fries. Mr. Lars Romell, of Stockholm, in reply to an inquiry concerning "Fung. Mexic." writes me, "So far as we can see — Dr. and Professor Fries have assisted me in this search — no work or paper of Elias Fries' hand exists under the name 'Fungi Mexicani.' What the designation 'Fung. Mexic.' will mean I can thus not say at present." It is possible that Fries' reference "Fung. Mexic." refers only to a collection of plants from Mexico, and Berkeley may have supplied the specific name or possibly have used a manuscript name of Fries, or one which Fries had labelled a specimen with and which may have been sent to Berkeley.

[18] See Arthur, J. C., on the Nomenclature of Fungi having many Fruit Forms, Plant World, *8*, 71-76, 99-103, 1905.

[19] See Farlow, W. G., Proc. A. A. A. S., *32*, 66, 1883.

[20] Hooker's Jour. Bot., , 227, 1854.

laeformis." These specimens I have not seen at the Kew Herbarium. But there are specimens from a collection of fungi by Ravenel, which came to Cornell University in the "Horace Mann Herbarium" from South Carolina, and marked in Ravenel's hand "*Dothidea vorax* Berk. et Curt., S. C. Rav." These specimens belong to *Balansia hypoxylon* and seem to agree in size more nearly with the specimens from Texas than with the specimens from Ohio, New York, etc., on Danthonia spicata. The pseudosclerotia as well as the stromata are larger than those on Danthonia spicata. This may be accounted for by the fact that the grass hosts of the Texas as well as the South Carolina specimens are stouter than the Danthonia spicata. The stromata are larger also than those in the Khasia specimen and this is probably what Berkeley refers to when he says "but others on Uniola are much larger than the Khasia specimens," since in his description of the Khasia specimens he refers to the stromata and not to the pseudosclerotium. "*Dothidea pilulaeformis* B. & C." seems never to have been described. It may be only a manuscript name and therefore is a "*nomen nudem,*" and cannot take precedence over *Balansia hypoxylon* (Pk.).

The name of the plant and its synonym with emended description would therefore be as follows:

BALANSIA HYPOXYLON (Pk.) Atkinson. Plates 81, 82, 83, 84 and Pl. 87, Figs. 17 and 18.

Epichloë hypoxylon Peck, 27th Rept. N. Y. State Mus. Nat. Hist., 108, 1875.

? Ephelis Fr. Summa Veg. Scand., p. 370, 1849 for genus.

? Ephelis mexicana Berkeley, Jour. Linn. Soc., *10*, 353, 1869.

Ephelis borealis E. & E., Jour. Myc., *1*, 86, 1885; North Am. Pyren, 91, 1892; E. & E., N. A. F., No. 3467 from Newfield, N. J., 1896.

Hypocrella hypoxylon Sacc., Syll. Fung., *2*, 581 ,1883.

Hypocrella hypoxylon Ellis p.p., North Am. Pyren, 91, 1892.

Dothichloë hypoxylon Atkinson p. p. (name only), Bull. Tor. Bot. Club, *21*, 223, 1894.

Pseudosclerotium curved, or more or less irregular, formed in the fruiting axis of the plant, 4-15 mm. long x 1-5 mm. in diameter, gray or blackish in color, whitish within and compact and somewhat brittle when dry, an abundant development of sclerotium elements in which the elements of the host (palae, leaves, axis, etc.) are imbedded, some of which are intact, others materially disintegrated and deformed. Stromata (fruit bodies) black, prominently pulvinate, depressed or rounded, plane or constricted at point of junction with the sclerotium, 1-4 mm. broad x 1-2 mm. high, surface minutely papillate from the ostiola of the perithecia. Perithecia flask-shaped, immersed, 200-400 x 100-200 μ, wall not very distinct from the stroma but evident from its dif-

ferent structure. Asci cylindrical with a tapering pedicel and a hyaline cap 'ce'll,' 120-200 x 6-8 μ. Spores 8, filiform, nearly the length of the ascus, about 1 μ in diameter, at maturity separating into segments 3-4 μ in length or longer. Conidial stage of the Ephelis type, stromata at first convex, emerging, then pezizoid and slightly margined. Conidia acicular, hyaline or pale yellowish, nearly straight or curved, ends obtuse, 15-25 x .5-.75 μ. On Danthonia spicata, Nova Scotia, Maine, Conn., New York, Ohio; and other grasses, South Carolina, Texas (?Mexico).

The name *Balansia vorax* might well be retained for that portion of Berkeley's species from Khasia occurring on the inflorescence of a Carex, especially since this form is the first one appearing in the original description. But since Berkeley gave an incomplete description of this form and confused it with a species of another generic type it may be well here to add a description of the species:

BALANSIA VORAX (B. & C.) Emend Atkinson. Pl. 87, Figs. 19 and 20. Pseudosclerotium in type specimen over 30 mm. long by 5-8 mm. in diameter, made up of elements of the fungus and the inflorescence of the host, of a coarse texture and rather coarse surface, more or less irregular in outline, not so smooth and compact as in *B. hypoxylon,* black. Stromata scattered over the surface, pulvinate, hemispherical or depressed, black, .5-1.5 μ in diameter, surface minutely punctate from the slightly projecting ostiola. Perithecia ovate, elliptical, 200-300 x 120-150 μ. Asci 150-180 x 6-7 μ. Spores 8, nearly as long as the ascus, separating at maturity into short segments. On inflorescence of some Carex, Khasia, India.

? BALANSIA DISCOIDEA P. Hennings. There are specimens of a fungus parasitic on the stem of an Andropogon from Kansas, in the Ellis Herbarium at the New York Botanical Garden marked "*Dothidea vorax* B. & C." in Ellis' handwriting, and with the following note in Kellerman's writing "On Andropogon, Kansas. Spores filiform, multinucleate, yellowish, 8 in an ascus. Kellerman & Swingle." These seem to be specifically different from both *Balansia hypoxylon* (Pk.) and *Balansia vorax* (B. & C.). The specimens which I have examined are rather old and asci and spores had disappeared from the stromata sectioned and shown in Plate 84, Fig. 11. The spores are, however, septate, 120-150 μ by slightly less than 1 μ in diameter and at maturity separate into short segments. A photograph of a portion of a grass stem affected by this fungus is shown in Plate 87, Fig. 19. The general stroma or pseudosclerotium is thin, dark gray, uniting only with the outer elements of the host. The stromata are prominent, discoid, sessile and punctate with the mouths of the perithecia and vary from .5-1.2 mm. in diameter. So far as one can judge from its appearance it seems to agree with *Balansia*

discoidea P. Hennings[21]. A photograph of this species is reproduced in Plate 88, Figs. *22, 23*, from a specimen from the Berlin Museum which I was able to obtain through the courtesy of Dr. Hennings. His description translated reads as follows:

"Balansia discoidea P. Henn. n. sp. Stromata in culms sclerotioid, blackened effuse for about 3- cm. gregarious, lenticular, discoid, frequently compressed, angular, 2-4 mm. diameter, surface punctate-rugulose, black, soft fleshy, drying horny, within pale; perithecia oblong-ovoid, immersed, punctate, ostiolate; asci oblong, cylindrical, apex globulose, truncate, base attenuate, 150-200 x 4-6μ, aparaphysate; spores filiform, longitudinally parallel, septulate, hyaline, about 0.6-8.8μ in diameter.

St Catherine, Blumenau, on Culms of Chloris distichophylla Lag. E. Ule. No. 1334." See Plate 88, Figs, 22, 23.

In the Kansas specimens the mycelium of the general stroma has made little invasion into the tissue of the host. The general stroma is dark gray while that of *Balansia discoidea* from Brazil is black. The latter also is soft and somewhat fleshy when fresh, hard when dry. The Kansas material is also hard and brittle when dry but what the condition was when fresh we have no record. It will be seen that the specimens differ slightly from those of *Balansia discoidea* from Brazil, but it seems better to locate them provisionally in this species. It is to be hoped that students and collectors will search for more of these specimens, endeavor to find the conidial stage, and to make careful notes on the characters of the plant as to consistency, etc., while it is fresh. Good service could be rendered by culture work in this genus.

Hennings says ,l. c. 78) that this species as well as *B. sessilis* P. Henn. from East Africa, in the sesile nature of the stromata show a transition to the Dothidiaceae. The perithecial walls, however, in B. discoidea from Brazil and in Kansas specimens are very distinct from the tissue of the stroma. The *Balansia sessilis*[22] P. Henn. occurs on culms of a species of Andropogon in East Africa. This is also close to *Balansia discoidea* and differs chiefly in the subglobose stromata and the more slender spores, which are $\frac{1}{2}$ μ in diameter. A translation of the descriptions is as follows:

"Balansia sessilis P. Henn. Stromata in black sclerotioid culms, sparse, sessile, subglobose, pulvinate, black, tuberculate, within pallid, fleshy, about 1$\frac{1}{2}$-2 m.m. diameter; perithecia immersed, ovoid; asci cylindrical, apex round, thickened, eight spored, base attenuate, 220-300 x 3$\frac{1}{2}$-4; sporidia longitudinally parallel, filiform, pluriguttulate or obsoletely septate, hyaline, scarcely $\frac{1}{2}$ μ thick. *Hab.* in culms of Andropogon species, Uluguru, tropical Africa (Goetze.)"

Since Balansia antedates Ophiodothis by three years, the name Ophiodothis cannot be retained for *Dothidea vorax* which was the first species placed in the genus by Saccardo[23]. Nor can the

[21] Heldw., 39 (77) 1900: Sacc. Syll. Fung., *16*, 608, 1902.
[22] Engl. Bot. Jahrb., *28*, 336, 1900. Sacc. Syll. Fung., *16*, 609, 1902.
[23] Syll. Fung. 2, 652, 1883.

genus name be retained for the other species confused both by Berkeley and Saccardo with the *Dothidea vorax,* namely *Dothidea atramentaria* which Saccardo lists as a variety of *O. vorax* (B. & C.) Sacc., and *D. pilulaeformis* also listed by Saccardo as a variety. Two other species were enumerated as belonging to this genus (l. c. 653). Of these *Ophiodothis haydeni* (B. & C.) Sacc.[24] cannot stand as the type of the genus Ophiodothis since it is a conidial stage of an imperfect fungus as I have found by examination of the specimens from the Kew Herbarium. The specimen in E. & E. Fungi Columbiani No. 1332 agrees with this. Berkeley's description reads as follows:

"881. Dothidea Haydeni B. & C. Irregularis papillata, sporidiis linearibus utrinque attenuatis. On stems of Aster and Erigeron, Nebraska, Hayden. No. 6404. Forming elongated, irregular, papillose patches, sporidia linear, attenuated at each end."

Berkeley did not give measurements of the spores. These are 15-25 x 3.5-4.5 μ, narrowly fusoid, or "linear and attenuated at each end." The stroma is thin and the pustules are irregular.

The third species (or the second one in order of position on the page) first placed by Saccardo in Ophiodothis (Syll. Fung., *2,* 653, 1883) is *Ophiodothis edax* (B. & Br.) — *Dothidea edax* B. & Br., and described by them as follows:[25]

"1167. D. edax B. & B. Minuta, punctiformis, nitida, e macula lutea oriunda; ascis lanceolatis; sporidiis filiformibus curvulis multinucleatis (No. 502). In leaves of Tephrosia suberosa. Sporida. .0002 long. On the same spots are minute bright scarlet tendrils consisting of extremely minute spores, which are probably a second form of "fructification."

This species I have not seen and, therefore, cannot express an opinion as to its generic position or whether it sufficiently meets the characters ascribed by Saccardo to his genus Ophiodothis. Later species, however, described after the appearance of Saccardo's publication of the genus come well within the genus and these might be regarded the types of the genus Ophiodothis. Of these I have had an opportunity of examining one, the *Ophiodothis tarda* Harkness[26]. It occurs on dead leaves of Rhus diversifolia. There is a thin[5] black, irregular, stroma, 3-4 mm. in diameter, punctate from the mouths of the perithecia. The asci are 53-75 x 9-11 μ, pedicellate. There are 8 filiform spores, slightly curved, continuous, guttulate and 30-45 x 2 μ.

[24] Dothidea haydeni B. & C., North Am. Fungi No. 881. Grev., *4,* 104, 1876.

[25] Enumeration of the Fungi of Ceylon Jour. Linn. Soc. Bot., *14,* 135, 1875.

[26] New California Fungi, Bull. 1, Cal. Acad. Sci., 46, 1884. See Saccardo Syll. Fung., *9,* 1051, 1891.

DOTHICHLOE.

In Berkeley's description of *Dothidea vorax* quoted above he made no note of the vegetative stroma or sclerotium of the Balansia form on the Cyperaceous plant from Khasia, as is evident from the words "black, subglobose, varying in size from a mere speck to that of a millet seed," . . . This applied to the fruiting stromata of the Balansia which are very easily seen in this part of the type on the pseudosclerotium which is the "deformed spike of some Carex."

The description further reads "or altogether effused, minutely granulated." This form is on Uniola and Panicum from South Carolina and is the form referred to by Berkeley as *Dothidea atramentaria.*[27] Berkeley never published a description of this species and it is evident from a study of the specimens in the Royal Herbarium at Kew with notes in Berkeley's handwriting that he confused the species names *atramentosa* and *atramentaria* which were applied by him to the same plant. For example, a part of the type of his *Hypocrea atramentosa*[28] is the No. 4018, on Andropogon, from Alabama. The type specimen now at Kew has the following note in Berkeley's handwriting: "No 4018. Hypocrea atramentaria B. & C., on Andropogon, Alabama, Beaumont," but when he published the species it was written *atramentosa.* On the same sheet in the Royal Herbarium at Kew is the specimen from Cuba also referred to *Hyprocrea atramentosa* in Berkeley's handwriting as follows: "419. Hypocrea atramentosa B. & C., Cuba, Wright."

While Berkeley never published any description of *"Dothidea atramentaria,"* Saccardo practically published a description of the plant as *"var. atramentaria"* of his *Ophidothis vorax*[29], which he drew up from the specimen in Rav. F. Am., No. 100.

The stroma of *Hypocrea atramentosa* B. & C. varies considerably, sometimes well and quite evenly developed, but always as a thin layer on the surface of the host and its thickness not exceeding the length of the perithecia or very slightly. The bases of perithecia, therefore, extend nearly to the surface of the host and there is only a very thin portion of the stroma between the bases of the perithecia and the host (see Plate 85, Fig. 1, a section of the type material of *Hypocrea atramentosa* B. & C.) while in Balansia there is an abundant development of the stroma between the bases of the perithecia and the pseudosclerotium. In other

[27] Notices of North American Fungi, Grev., *4,* 105, 1876. I wish here to express my obligations to Dr. Dyer, Director of the Royal Gardens at Kew, and to Mr. Massee of the Hebarium for the privileges extended to me in the examination of Berkeley's types of the species mentioned in this article.

[28] Journ. Linn. Soc., *10,* 377, 1869.

[29] Syll. Fung., *2,* 652, 1883.

cases the stroma is more or less separated into patches, sometimes these patches being rather small when they appear as irregular, angular or roughly circular disciform bodies which suggest a resemblance to the stromata of Balansia, but differ in the absence of the pseudosclerotium, and especially in the fact that the well developed stroma of Balansia between the bases of the perithecia and the host is lacking.

As stated above in 1894 I proposed the genus Dothicloë for those species of Hypocrella Sacc. which are congeneric with *Hypocrea atramentosa* B. & C. Hypocrella [30] was proposed by Saccardo for forms like *Hypocrea discoidea* B. & Br. and *H. atramentosa* B. & C., having asci and spores like Epichloë but the stroma of which does not entirely surround the host.

Hypocrea discoidea and the first species given by Saccardo in the Sylloge under the genus[31] *Hypocrella phyllogena* (Mont.) Speg., in my opinion are not congeneric with *Hypocrea atramentosa* B. & C., *H. discoidea* being thick, discoid and scarlet in color, *H. Phyllogena* being thick, tubercular or discoid (the thickness equalling or exceeding the diameter) and whitish in color, according to specimens which I have seen in the Herbarium of the Museum of Paris; while *H. atramentosa* is thin, effuse and black. *Hypocrea atramentosa* may be regarded by some as belonging in the genus Epichloë, but because of its black stroma in my opinion it is not congeneric with Epichloë, though it is closely related and should be retained in the Hypocreales just as Balansia and Claviceps are, because the perithecial walls while not very distinct are still of a different structure from the tissue of the stroma, although Saccardo (1. c.) placed forms of *H. atramentosa,* example *"Dothidea atramentaria"* B. & C. in the Dothidiaceae, and in 1894 I considered the species as belonging to the Dothideaceae. The genus Dothichloë represents a transition of the Sphaeriales to the Dothideales. While I formerly mistook, as stated above, specimens of *Hypocrea atramentosa* B. & C., which were distributed in various Exsiccatae as *Hypocrea hypoxylon* (Pk.) for "authentic" specimens of Peck's *Epichloe hypoxylon,* the diagnosis of the genus Dothichloë was drawn from fresh specimens of *Hypocrea atramentosa* on leaves of Andropogon from Alabama, and of another species on stems of Aristida also from Alabama. The specimens on leaves of Andropogon have since been compared by me with the type specimens of *Hypocrea atramentosa* B. & C. at Kew and have been found to be identical. It will be sufficient therefore to make the necessary correction in the name *Dothichloe atramentosa* (B. & C.) Atkinson, in place of *Dothichloe hypoxylon* (Pk.) Atkinson, and in the synonymy citations. It may be well, therefore, in order to make matters clear to repeat here the diag-

[30] Michelia, *1,* 322, 1878.
[31] Syll. Fung., *2,* 579, 1883.

nosis of the genus and of the two species as published in 1894 [32], and to correct the synonymy, with such slight changes as may now seem necessary.

DOTHICHLOE Atkinson, Bull. Torr. Bot. Club, *21,223*, 1894.

Stroma thin, hard when dry, black, especially the outer portions, lighter within, but the dark color is present to a considerable depth, effuse, pulvinate, disciform or armillae-form, partly or entirely surrounding the host or substratum, continuous or interrupted and then a thin sterile portion continuous as in *D. aristidae,* but then not developed to an appreciable extent between the bases of the perithecia and the host. Perithecia crowded, confluent with the stroma, but thin walls distinct and of a different structure from the surrounding stroma, immersed, the apex projecting above and giving the stroma a granulose, rugose or convolute appearance. Asci cylindrical, 8-spored. Spores filiform, septate when mature, and eventually separating at the septa into short segments.

DOTHICHLOE ATRAMENTOS (B. & C.) Atkinson, Pl. 85, and Pl. 88, Figs. 25-27.

Hypocrea atramentosa B. & C., Jour. Linn. Soc., *10*, 377, 1869, Grev., *4*, 15, 1875. Royal Herb., Kew. "No. 419 Fungi Cubenses, Wright." "No. 4018 on Andropogon, Alabama, Beaumont."

Dothidea vorax B. & C., p.p. Grev., *4*, 105, 1876.

Dothidea atramentaria B. & C., Grev., *4*, 105, 1876.

Hypocrella atramentosa Sacc., Mich., *1*, 323, 1878. Syll. Fung., *2*, 581, 1883.

?Ophiodothis vorax var. atramentaria Sacc. Syll. Fung., *2*, 652, 1883.

?Dothidea atramentaria Rav. Fung. Am., No. 100.

?Dothidea atramentaria Ellis & Everhart N. A. F., No. 683.

Hypocrella hypoxylon Ellis, p.p. N. A. Pyren., 91, 1892.

Hypocrella hypoxylon E. & E. N. A. F., No. 2373.

DOTHICHLOE HYPOXYLON Atkinson p.p. (name only) Bull. Torr. Bot. Club, *21,223*, 1894. Some Fungi from Alabama, Bull. Cornell Univ. Science, *3*, 19, 1897.

Stroma 5-20 mm. long (or sometimes longer), usually occupying one side of the leaf and may be either epiphyllous or hypophyllous. Perithecia 100-150 μ in diameter and nearly twice as long, the conical apices projecting slightly above the stroma give it a granulose appearance. Asci 150-200 x 4-5 μ, linear, tapering to a slender point at the base and crowned by a hyaline truncate apex or cap "cell." Spores nearly the same length as the asci, but about 1 μ in diameter, curved and interwoven in the ascus.

[32] Bull. Torr. Bot. Club, *21*, 223, 224, 1894.

This species is very common on grasses in the Southern States, especially on Andropogon in Alabama and probably in nearby States (Andropogon virginicus, Eragrostis tenuis and Eragrostis campestris; Auburn, Alabama). On Panicum agrostoides (No. 2373 E. & E. N. A. F.) Jackson, Miss., on grass, Irby, Ga., Tracy; Cocoanut Grove, Florida, Thaxter. The specimens which I have seen of *"D. atramentaria"* Rav. Fung. Am. No. 100, Ellis & Everh. N. A. F. No. 683 have a very thin stroma. They either represent depauperate forms, or a different species, probably the former. Cultures and studies of development are needed to settle this point. In some cases I have found the stroma of this species, *Dothichloe atramentosa,* so situated on the underside of the leaves of a single plant as to indicate that in the young stage both of the host and parasite the young stroma entirely surrounded the cluster of leaves before they had elongated. As the leaves elongate some elongate more than others, tear apart this common young stroma and we then find it situated on the under side of all the leaves of that cluster, but separated as shown in Plate 88, Fig. 25. It will be remembered that one of the important characters of the genus Hypocrella as given by Saccardo (l. c.) was the unilateral position of the stroma in contradistinction to the enveloping character of the stroma of Epichloe. Where the stroma is effuse as it is in *Dothichloe atramentosa* and related species the host has more influence in determining its partial or complete envelopment. In this species the fungus may begin its development with the position on the host ascribed to one genus, but is finally cast in the character of another genus by the growth and unequal elongation of members of the host. This together with the fact that in *Dothichloe aristidae,* a closely related species, the stroma normally surrounds the stem of the host, lessens the value of the unilateral position of the effuse stroma as a generic character. On the other hand the peculiar deep and restricted character of the stromatic bodies of *Hypocrella phyllogena* (Mont.) Speg. and *Hypocrea discoidea* (B. & Br.) Sacc. of itself limits the extent of the stroma without regard to the host. This together with the difference in color, texture, etc., well separates these species genericaly from a plant of the type of *Hypocrea atramentosa.* Hypocrella Sacc. might well be retained for *H. phyllogena, H. discoidea* and other congeneric species.

DOTHICHLOE ARISTIDAE Atkinson *33*. Pl. 88, Figs. 28, 29. Stroma dimorphic, sterile portion confluent, forming a thin black layer, in the specimens seen entirely surrounding the culm. Fertile portion much thicker, confluent or interrupted, forming small perpendicular elevations on the sterile portion, but not forming distinct stromata as in Balansia since it is always thin beneath the bases of the perithecia as in *D. atramentosa.* Projecting apices

[33] Bull. Torr. Bot. Club, *21*, 224, 1894.

of the crowded perithecia more or less confluent in an irregular manner giving a tuberculose, rugulose or convolute appearance to the stroma and more prominent than in *D. atramentosa,* otherwise as in *D. atramentosa.* On Aristida purpurascens, Auburn, Alabama, collected by B. M. Duggar. On Aristida dichotoma, Auburn, Alabama, C. L. Newman. On grass which resembles Aristida, at Cocoanut Grove, Florida, Dr. Thaxter collected specimens which probably belong to this species, but the perithecia are old and sterile in the specimens which I have seen.

The simple agreement in character of the asci and spores of these species cannot be taken as of specific identity where there are other characters sufficiently distinct, for there is no appreciable difference between the asci and spores of *Epichloe typhina* and those of *Dothichloe atramentosa*, and in several species of Cordyceps they are very similar.

While I have found the perithecia bearing stroma only on the stems, the leaves of affected plants often show a very thin black sterile stroma. Whether this sterile stroma on the leaves is formed by the same fungus or not I cannot say. It would seem that it should bear perithecia if it is specifically identical with *Dothichloe atramentosa.* But since the stroma only fruits on the stems (provided the sterile stroma on the leaves belongs to the same fungus) this would be another indication of its being a distinct species.

ECONOMIC IMPORTANCE OF THE SPECIES.

Aside from the very interesting feature in the morphology of the species of these two genera, and the interesting and intricate history of their synonymy, they are of special interest in relation to their hosts because of their possible economic importance. So far as we knew they are strictly parasites. The species of the genera at present known are intrinsically parasites of the grasses, and all the species with which I am at present familiar in the United States attack living grasses. Because of the great importance of the grasses for pasturage and forage any fungus which is capable of causing disease or injury to members of this order at once becomes of considerable economic importance, even though at present the percentage of injury which they cause is small. We do not know at what moment a change may occur which may favor the more rapid multiplication of the parasite and the susceptibility of the host, as well as the spread of the parasite to some of the grasses which are now of greater economic importance than those which at present constitute the hosts of the parasite. This change to other hosts could very well take place by the evolution of some biologic form especially organized to successfully overcome the new host. The primary attack could be made through a vulnerable point due to physiological conditions of the

host, or to some accidental injury. Having once obtained a foothold in the new host there would be a chance of its adaptation to the new environment and the acquirement of new biological properties which would enable it to attack other individuals of the same host, just is it is possible now, by artificial means to transplant one biologic form of a parasite from its normal non-resistant host over to another host which under ordinary conditions is immune or not susceptible to this biologic form[34].

The development of new varieties of grasses as well as the tests of feral species which are now being carried on by the United States Department of Agriculture for the purpose of selecting those species which are suitable for cultivation, and also the cultivation of these or old varieties under new conditions of environment or with more intensive methods of cultivation or seletion may play an important part in opening the way for the propagation, distribution and increasing adaptation of these fungi so that their injuries may be greatly increased. Some such course, or phase of evolution as outlined here probably has marked the history of most of the fungi parasitic on domesticated plants and accounts in a measure for the sudden outbreaks of biologic forms on hosts formerly immune, of the sudden appearance of a parasite in greatly increased virulence of attack which formerly produced very limited injury, or of the migration of parasitic fungi from ferel plants to domesticated ones where in the new and often more favorable environment the disease caused by it does great injury and becomes a permanent menace to the successful cultivation of the host.

Balansia hypoxylon has been found on Danthonia spicata in the Northern United States and in Nova Scotia and probably occurs sparingly throughout the normal distribution of this host. That it occurs on other species of grasses is shown in its collection by Long in Texas on an undetermined species of grass, which however is not Danthonia spicata, and possibly it is the same species of grass on which was collected the conidial stage, Ephelis mexicana in Mexico, and it also occurs on a grass in South Carolina as shown above. The fungi on these hosts are probably one species and are so treated in the present paper. This indicates that the fungus may in the future be found on other hosts or even may spread to new ones. Whether the forms on the dif-

[34] See Salmon, E. S., Cultural Experiments with Biologic Forms of the Erysiphaceae, Ann. Bot., *18*, 320, 321, 1904. Proc. Roy. Soc., *73*, 116-118, 1903. Proc. B. A. A. S. Southport meeting, 1903. On specialization in Parasitism in the Erysiphaceae. Beihefte 2, Bot. Centralb., *14*, Heft 3, 261-315, pl. 18, 1903.

Cultural experiments with the Barley Mildew, Erysiphe graminis D. C., Ann. Myc., *2*, 70-79, 1904. The New Phytologist, *3*, 109-121, 1904. Ann. Myc., *3*, 172-184, 1905. On Erysiphe graminis D. C., and its adaptive parasitism within the genus Bromus, Ann. Myc., *2*, 255-267, 307-343, 1904.

ferent hosts are biologic forms or not, or whether the form in Texas is a different species can only be determined by cultural work. At any rate they are very closely related and have without question descended from one and the same species. So that whether in the future it shall be shown that these are but one species viable on several hosts or whether there are biologic forms or biologic species with considerable fixity confined to distinct species of host, does not militate against the possibility of a still further extension in the range of hosts or the virulence of their attack. So far as we know at present the Banansia hypoxylon attacks only the fruiting spike and causes abortion of the same so that seeds are not developed. Affected plants, therefore, are not productive and should the fungus ever become very prevalent and common it would seriously interfere with the normal means of propagation of the host species.

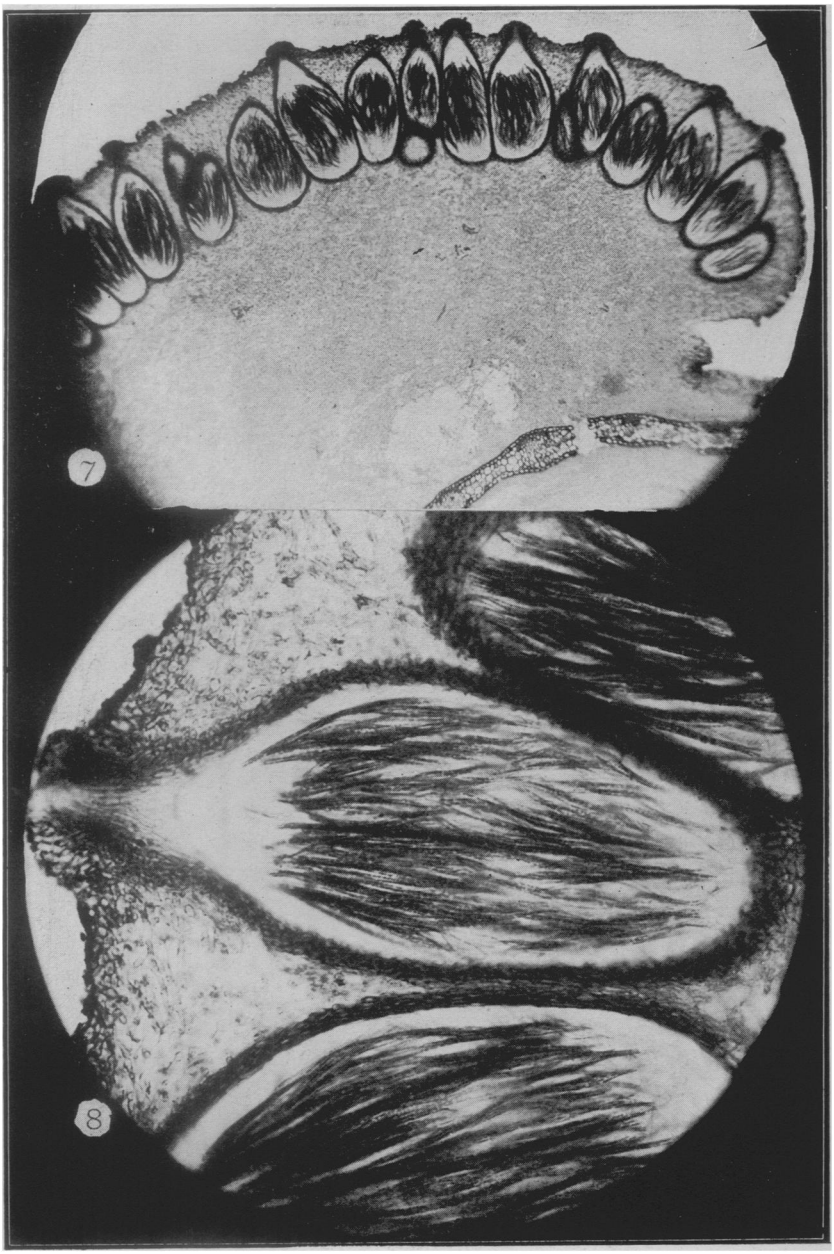
The species of Dothlichloë are much more common, are abundant and widely distributed in the Southern United States and rare in the Northern United States. Dothichloë atramentosa especially is common on Andropogon and other grasses. While strictly parasitic so far as we know it is more viable on different hosts than Balansia hypoxylon, though it must be borne in mind that the same problem of biologic forms holds good here which in this case also can only be settled by future investigation. This species as limited here attacks only the leaves, but seems to be tardy in development so that the leaves are often well formed. Whether plants affected by this parasite ever form seed or not I have not observed, but in many cases the attack as I have seen it does not seem to be sufficiently severe to prevent the development of the axis and of mature seed.

Dothichloë aristidae attacks the stems which it surrounds and injures to such an extent that, so far as I have observed no spikes or at least no seeds are formed.

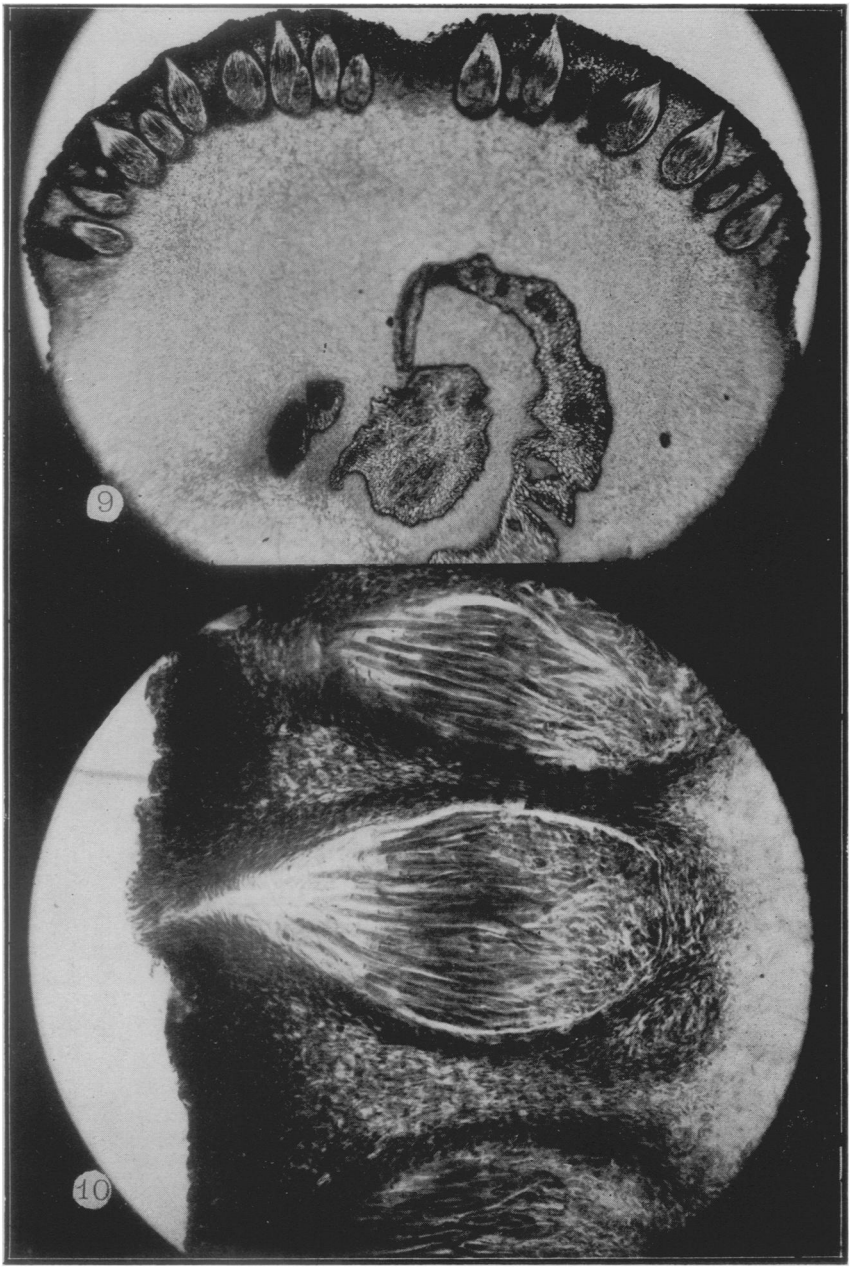
During the coming season, or at any future time, I should be very glad to receive in abundance or in small quantity specimens of these or other related species in a fresh condition with a sufficient portion of the host for photographing and for identification.

I wish to acknowledge my obligations to Dr. T. Dyer, director of the Royal Herbarium at Kew, Mr. Massee of the same Herbarium, Mr. Hariot of the Herbarium of the Musée d'historire Naturelle at Paris, Dr. P. Hennings, of the Berlin Museum, and Dr. Britton, director of the New York Botanical Garden, for courtesies shown in allowing me to examine the herbarium specimens; to Dr. K. Miyaka and Dr. Charles E. Lewis, formerly graduate students and assistants in the Department of Botany at Cornell University for sectioning the material of Balansia hypoxylon and Dothichloë atramentosa; and to Dr. Thaxter of Harvard University and Professor Kellerman of Ohio State University for contributing specimens from their herbaria;

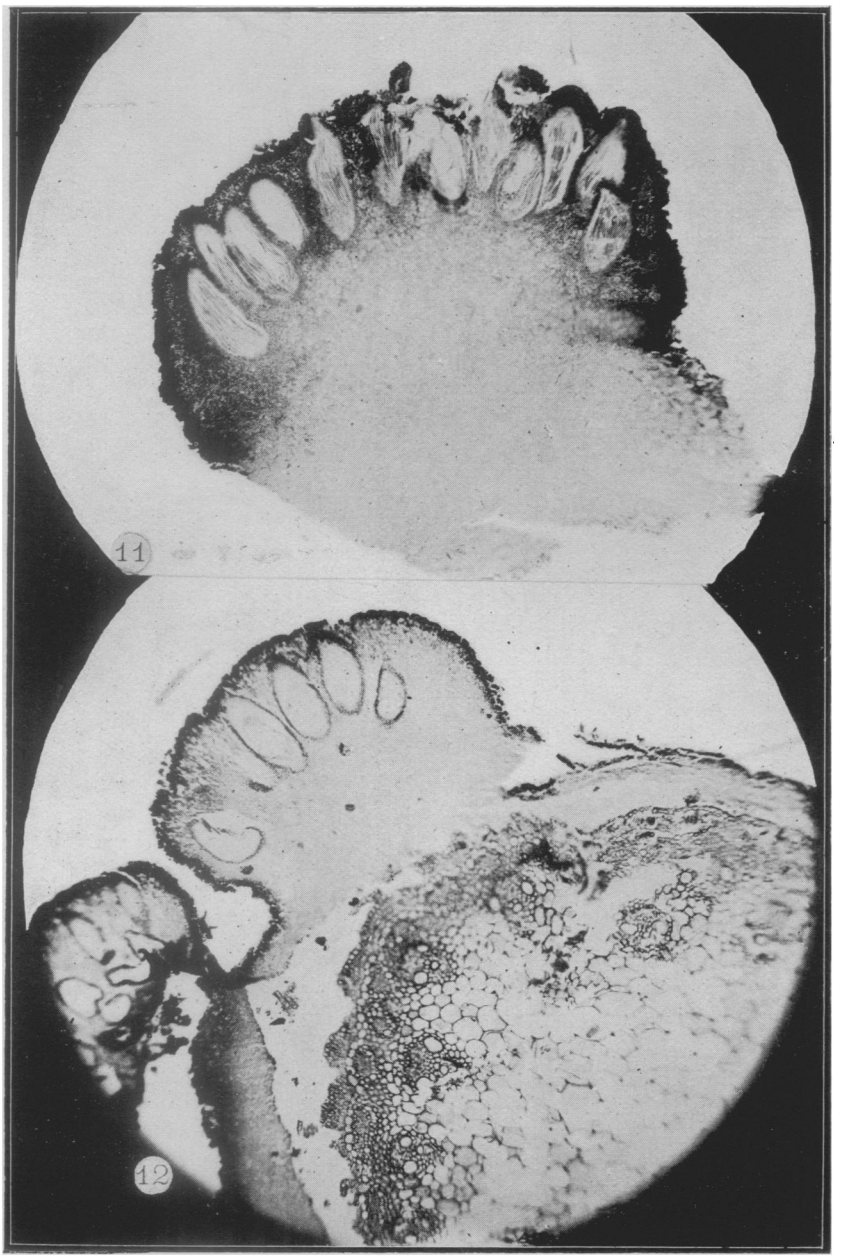
BALANSIA HYPOXYLON (PK.) ATKINSON.



BALANSIA HYPOXYLON (PK.) ATKINSON.

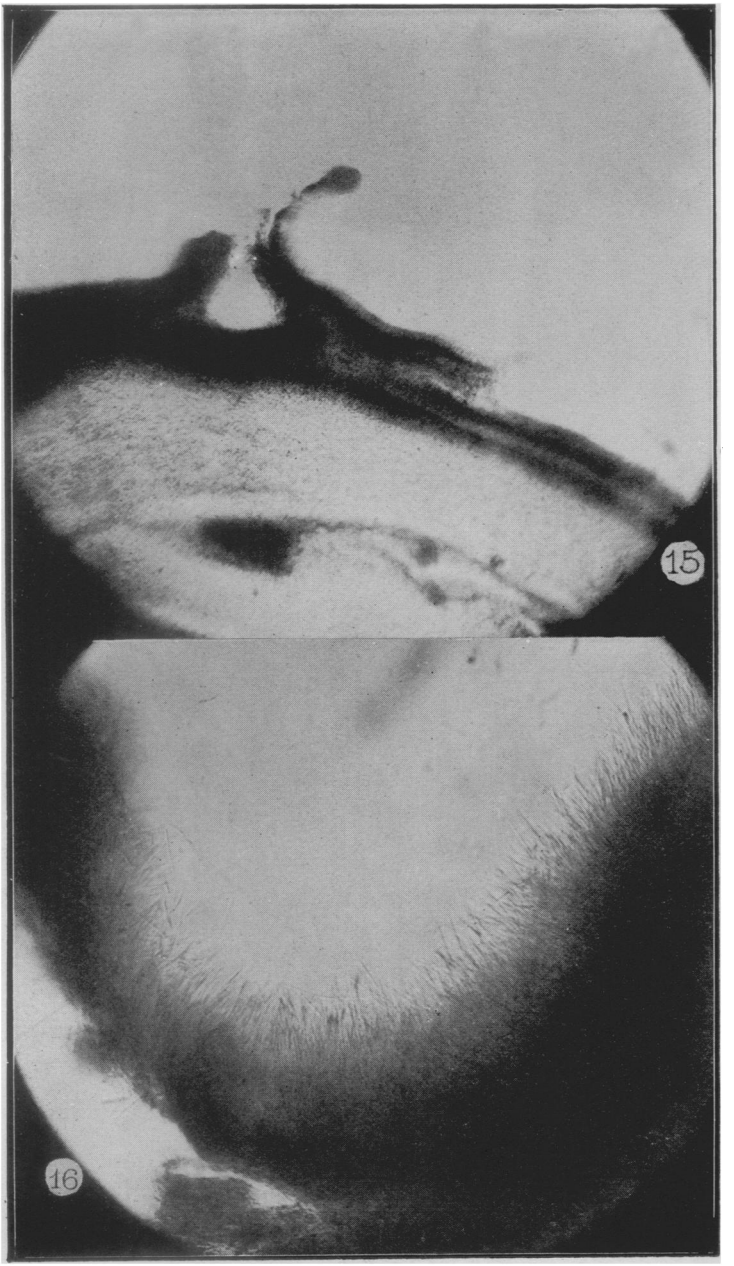


BALANSIA HYPOXYLON (PK.) ATKINSON.

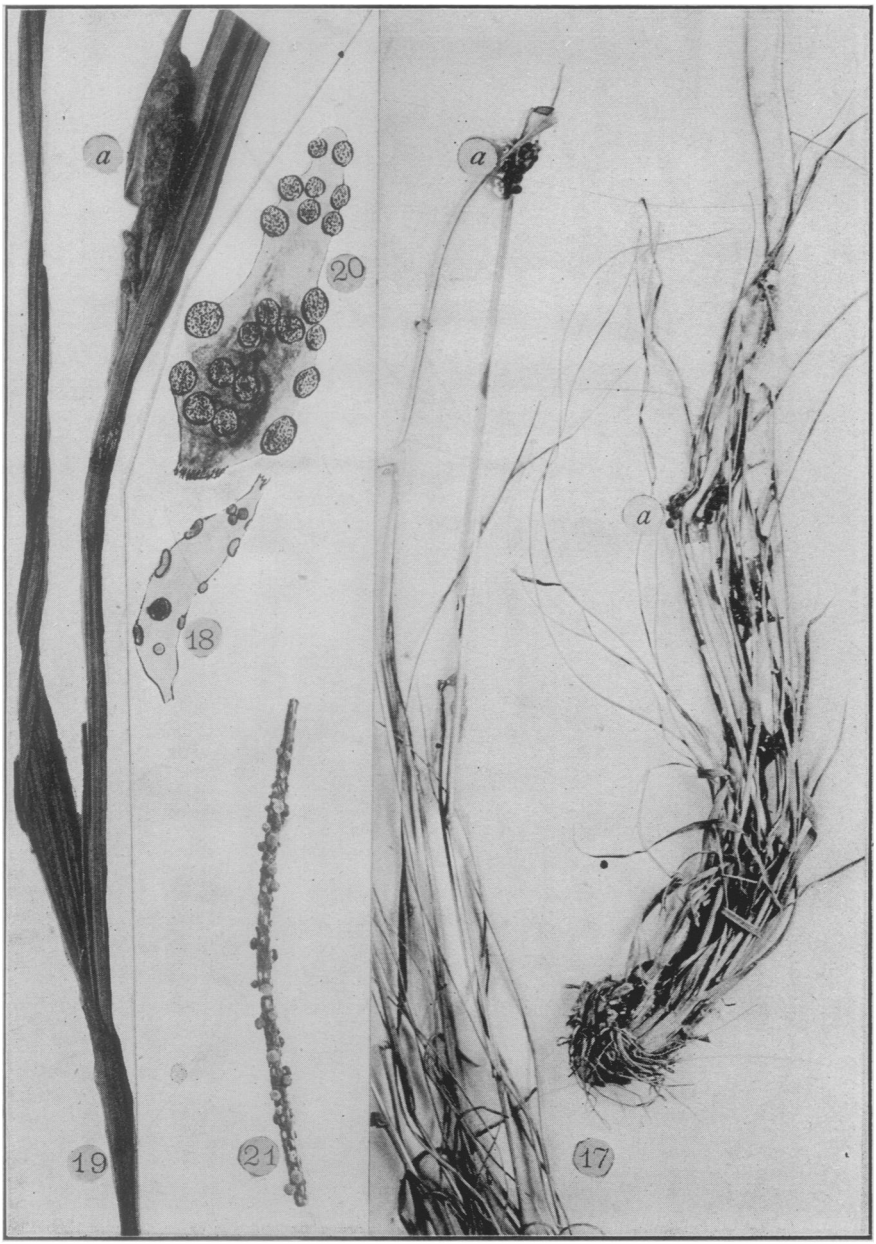


BALANSIA VORAX (B. and C.) ATKINSON.

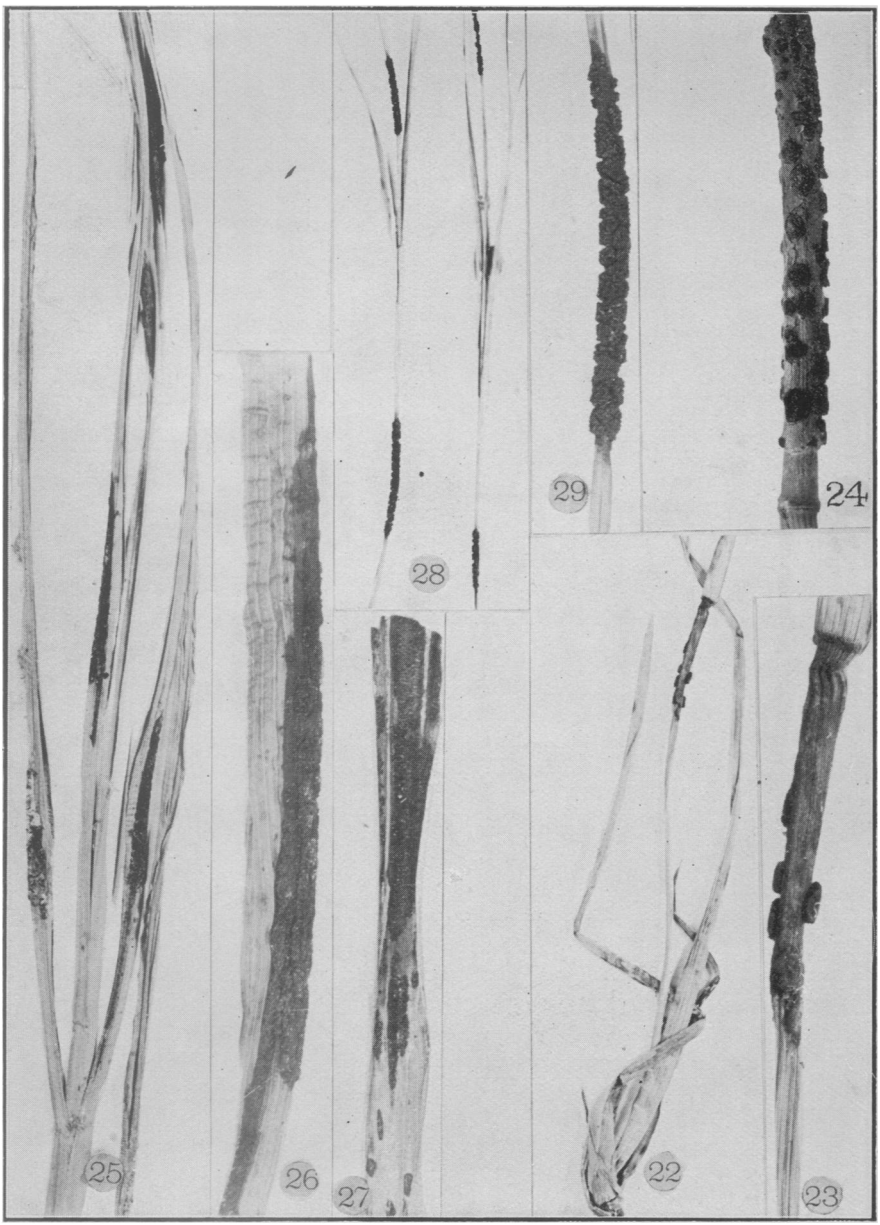
DOTHICHLOE ATRAMENTOSA (B. and C.) ATKINSON.



BALANSIA HYPOXYLON (PK.) ATKINSON.



BALANSIA HYPOXYLON (PK.) ATKINSON.



BALANSIA DISCOIDEA P. HENNINGS.

and to my collegue, Dr. E. J. Durand, for saving me some time by assisting me with some of the references.

EXPLANATION OF PLATES.

The photographs and photomicrographs were made by the author.

The photomicrographs were made with aid of a Zeiss microscope.

Plate 81. Balansia hypoxylon (Pk.) Atkinson.

Figs. 1-3 on grass from Texas. Fig. 1, pseudosclerotium with stromata magnified about five times the real length and diameter. Fig. 2, section of pseudosclerotium and two stromata on opposite sides showing deformed stem, leaf and floral elements in center of pseudosclerotium, and the perithecia near surface of the stromata, still more highly magnified. Fig. 3, ascus with spores. Drawn by K. Miyaké.

Figs. 4-6 on Danthonia spicata from Ohio. Fig. 4, pseudosclerotium with stromata magnified about five times the real length and width. Fig. 5, section of pseudosclerotium and one stroma, showing stem and leaf elements, etc., in the pseudosclerotium, and the perithecia near surface, still more highly magnified. Fig. 6, ascus with spores. Drawn by K. Miyaké.

Plate 82. Balansia hypoxylon (Pk.) Atkinson, on inflorescence of Danthonia spicata, Ohio.

Fig. 7 showing section through a stroma showing perithecia with asci, and a very small portion of the pseudosclerotium. Fig. 8, a perithecium in the stroma more highly magnified showing wall, ostiolum and asci with ascospores. Fig. 7, photomicrograph with ocular 6, objective 16 mm., the plate holder being 360 mm. from the object. Fig. 8, photomicrograph with ocular 6, and objective 3 mm., the plate holder being 360 mm. from the object.

Plate 83. Balansia hypoxylon (Pk.) Atkinson, on inflorescence of grass, Texas.

Fig. 9, section of stroma with asci and part of pseudosclerotium.

Fig. 10, perithecium in stroma more highly magnified, showing wall, ostiolum and young asci.

Fig. 9, photomicrograph with ocular 6 and objective 16 mm., the plate holder being 360 mm. from the object.

Fig. 10, photomicrograph with ocular 6 and objective 3 mm., the plate holder being 360 mm. from the object.

Plate 84. Fig. 11, Balansia vorax (B. & C.) Atkinson, from type material of Dothidea vorax B. & C. from Khasia, India, in Royal Herbarium at Kew. Section of a stroma or fruit body showing perithecia. Photomicrograph with ocular 6, objective 16 mm., the plate holder being 360 mm. from the object.

Fig. 12, Balansia discoidea P. Hennings, on stem of Andropogon, Kansas, marked "Dothidea vorax B. & C." in Ellis Herbarium now in Herbarium New York Botanical Garden. Showing section of a stroma or fruit body and a portion of stem with enveloping sterile stroma or pseudosclerotium. Photomicrograph with ocular 6 and objective 16 mm., the plate holder being 360 mm. from the object.

Plate 85. Dothichloë atramentosa (B. & C.) Atkinson, part of type of Hypocrea atramentosa B. & C., in Royal Herbarium at Kew "No. 4018 on Andropogon, Alabama, Beaumont."

Fig. 13, section through the general stroma and leaf showing perithecia.

Fig. 14, perithecium of same, more highly magnified showing wall, ostiolum and asci with spores.

Fig. 13, photomicrograph with ocular 6 and objective 16 mm., the plate holder being 360 mm. from the object.

Fig. 14, photomicrograph with ocular 6 and objective 3 mm., the plate holder being 360 mm. from the object.

Plate 86. Balansia hypoxylon (Pk.) Atkinson. Ephelis stage, Ephelis borealis E. & E.

Fig. 15, free hand section through peziza-like fruit body and portion of pseudosclerotium.

Fig. 16, angle in cup of same more highly magnified showing the very slender spores.

Fig. 15, photomicrograph with ocular 6, objective 16 mm., the plate holder being 360 mm. from the object.

Fig. 16, photomicrograph with ocular 6, objective 3 mm., the plate holder being 360 mm. from the object.

Plate 87. Figs. 17 & 18. Balansia hypoxylon (Pk.) Atkinson.

Fig. 17, photograph of Danthonia spicata showing pseudosclerotium with the rounded stromata at *a*, real size. Note much smaller size of the pseudosclerotium and much larger size of the stromata than in B. vorax fig. 19.

Fig. 18, the Ephelis stage (Ephelis borealis E. & E.) enlarged about six times the real length, showing pseudosclerotium with peziza-like fruit bodies, from free hand sketch.

Figs. 19 and 20, Balansia vorax (B. & C.) Atkinson.

Fig. 19, photograph, real size, of type specimen from Khasia, India, now in Royal Herbarium at Kew, England, the large pseudosclerotium in inflorescence at *a*.

Fig. 20, small portion of the pseudosclerotium with stromata magnified about ten times the real length and width, from free hand sketch.

Fig. 21, Balansia claviceps Speg., photograph real size, of portion of specimen from Royal Herbarium, Kew, on stem of Panicum, Paraguay. Note that many of the stromata are sessile.

Plate 88. Figs. 22 and 23. Balansia discoidea P. Hennings, on stem of Chloris distichophylla, Brazil.

Fig. 22, real size, pseudosclerotium and stromata at *a*.

Fig. 23, same magnified 3 times real length and width.

Fig. 24, Balansia discoidea P. Hennings, on stem of Andropogon, Kansas, magnified 3 times the real length.

Figs. 25-27, Dothichloë atraemntosa (B. & C.) Atkinson.

Fig. 25, photograph, real size, of Andropogon plant from Alabama showing black effuse stromata on under side of the leaves. This plant indicates that when the host and fungus were young the young stroma entirely surrounded the cluster of leaves, but when the leaves elongated they tore the enveloping stroma apart.

Fig. 26, a single stroma on under side of a leaf magnified 3 times the real length and width.

Fig. 27, photograph magnified 3 times the real length and width of very thin stroma on leaf of grass, of No. 683 E. & E. N. A. F. This is the same form as occurs in Rav. F. C. Ex. No. 100 which usually bears the name "Dothidea atramentaria B. & C." See text for discussion.

Figs. 28, 29, Dothichloë aristidae Atkinson, on stems of Aristida purpurascens, Alabama.

Fig. 28, real size.

Fig. 29, magnified three times the real length and width. Note that the perithecia are larger and much more prominent in Fig. 29 than in Fig. 20 where they do not show because not so prominent.

ANOTHER FLY AGARIC.

D. R. SUMSTINE.

Amanita muscaria is called the fly agaric because infusions of it are poisonous to flies. It has now, however, a keen rival for this reputation in another species of the same genus. Last summer while drying specimens of *Amanita olitaria Bull,* a number of flies were attracted to them. After the flies had remained on the plants for a short time they fell over apparently dead. This continued until thirty-nine fly mycophagists had become the victims of some narcotic contained in the mushrooms. The box with flies and plants was then set aside for future study. After two hours the box was again examined, but the flies which once were dead were now alive and had departed with no more serious results possibly than a severe headache from their mycological "booze."